

EXHIBIT R

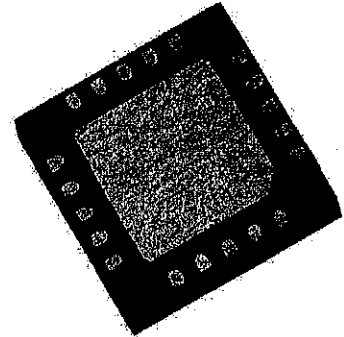
Honeywell

HRF-SW1020

SP4T Absorptive RF Switch DC To 2.5 GHz Operation

The Honeywell HRF-SW1020 is a high performance single pole four throw (SP4T) absorptive RF switch that is ideal for use in wireless basestation and handset applications that require minimum power and minimum insertion loss.

The HRF-SW1020 is manufactured with Honeywell's patented Silicon On Insulator (SOI) CMOS technology, which provides the performance of GaAs with the economy and integration capabilities of conventional CMOS technology. These switches are DC coupled to improve lower operating frequency, frequency response and reduce the number of DC bias points required.



FEATURES

- Typical High Isolation Of > 40 dB @ 2 GHz
- Typical Low Insertion Loss Of 1.7dB @ 1 GHz
- Integrated CMOS Control Logic
- DC-coupled, bi-directional RF Path
- Single Positive Supply Voltage
- Ultra Small VQFN Packaging
- Impedance matched for 50 Ohm systems

Pushbutton available switches

RF ELECTRICAL SPECIFICATIONS @ + 25°C

Results @ $V_{DD} = 5.0 \pm 10\%$, $V_{SS} = 0$ unless otherwise stated, $Z_0 = 50$ Ohms
Contact Honeywell for relative performance at other supply configurations

Parameter	Test Condition	Frequency	Minimum	Typical	Maximum	Unit
Insertion Loss		1.0 GHz		1.6	1.9	dB
		2.0 GHz		1.7	2.2	dB
		2.5 GHz		1.8	2.3	dB
Isolation		1.0 GHz	45	54		dB
		2.0 GHz	33	41		dB
		2.5 GHz	30	39		dB
Return Loss			-15	-20		dB
Input P1dB	$V_{SS} = \text{Gnd}$ $V_{SS} = -5V$	1.0 GHz		17		dBm
		1.0 GHz		27		dBm
Input IP3	Two-Tone Inputs, up to + 5 dBm $V_{SS} = \text{Gnd}$ $V_{SS} = -5V$	2.0 GHz		35		dBm
		2.0 GHz		36		dBm
Trise, Tfall	10% To 90%			10		ns
Ton, Toff	50% Cntl To 90% / 10% RF			20		ns

HRF-SW1020**DC ELECTRICAL SPECIFICATIONS @ + 25°C**

Parameter	Minimum	Typical	Maximum	Units
V _{DD}	3.3 ¹	5.0	5.5	V
V _{SS}	-5.0			V
I _{DD}		<5	35	uA
CMOS Logic Level (0)	0		0.8	V
CMOS Logic Level (1)	V _{DD} - 0.8		V _{DD}	V
Input Leakage Current			10	uA

Note 1 - Performance curves are for VDD = +5.0 +/- 10%

ABSOLUTE MAXIMUM RATINGS¹

Parameter	Absolute Maximum	Units
V _{DD}	+6.0	V
V _{SS}	-5.5	V
Vin Digital Logic 0	-0.6	V
Vin Digital Logic 1	Vdd + 0.6	V
Input Power	> 35	dBm
ESD Voltage ²	400	V
Moisture Sensitivity Level	Level 3 @ 240°C	
Solder Reflow Temperature	250	°C
Operating Temperature Range	-40 to +85	°C
Storage Temperature Range	-65 to +125	°C

Note 1 - Operation of this device beyond any of these parameters may cause permanent damage.

Note 2 - Although the HRF-SW1020 contains ESD protection circuitry on all digital inputs, precautions should be taken to ensure that the Absolute Maximum Ratings are not exceeded.

Latch-Up: Unlike conventional CMOS digital attenuators, Honeywell's HRF-SW1020 is immune to latch-up..

TRUTH TABLE

G1	VDD	RF Output 1	RF Output 2	RF Output 3	RF Output 4
0	0	RFINPUT	RFINPUT	RFINPUT	RFINPUT
0	1				
1	0	RFINPUT	RFINPUT	RFINPUT	RFINPUT
1	1				

"0" = CMOS Low, "1" = CMOS High

PIN CONFIGURATIONS

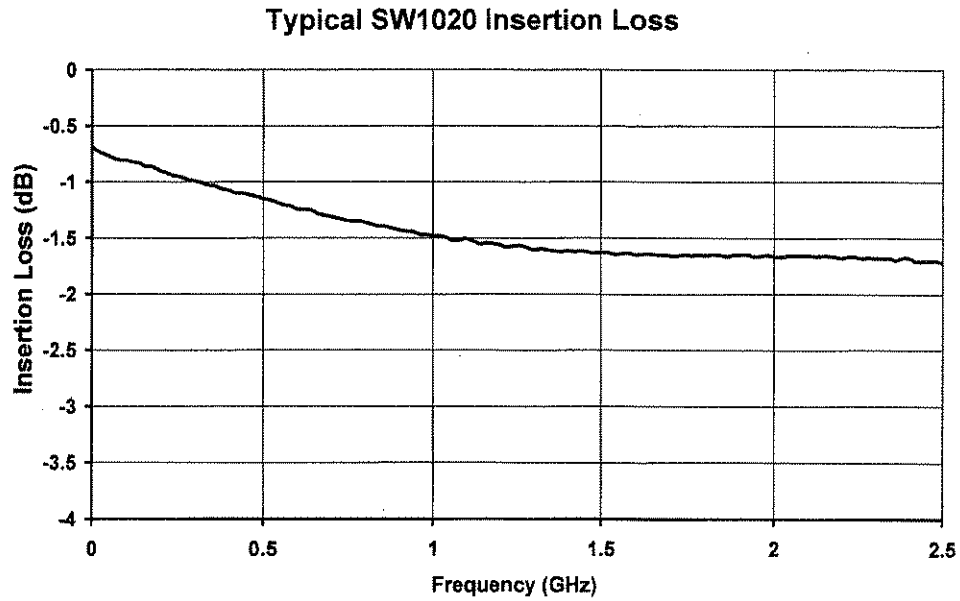
Pin	Function	Pin	Function	Pin	Function	Pin	Function
1	GROUND	6	RFOUTPUT3	11	C1	16	GROUND
2	RFOUTPUT4	7	GROUND	12	C0	17	GROUND
3	GROUND	8	GROUND	13	GROUND	18	RFINPUT
4	VDD	9	GROUND	14	RFOUTPUT1	19	GROUND
5	GROUND	10	RFOUTPUT2	15	GROUND	20	VSS

Note: Bottom ground plate must be grounded for proper RF performance.

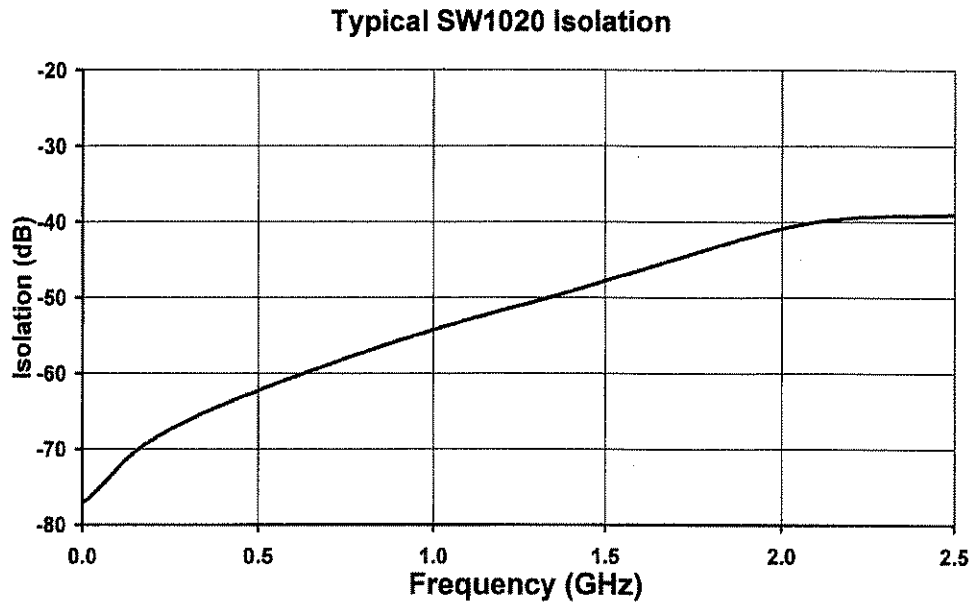
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PERFORMANCE CURVES

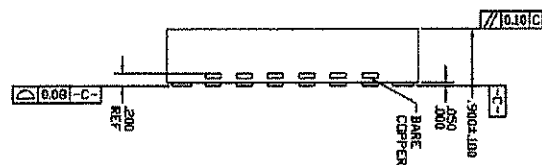
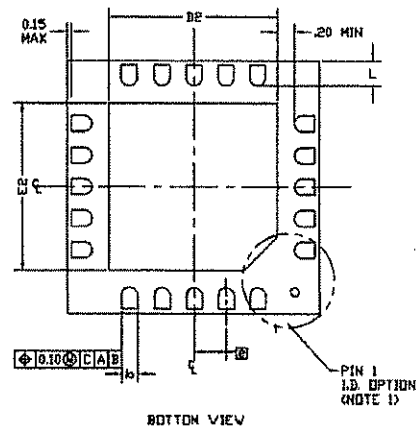
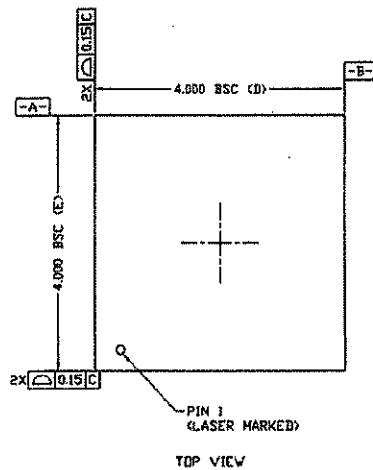
Insertion Loss



Isolation



PACKAGE OUTLINE DRAWING



MIN	NOM	MAX
0.50	BSC	
0.18	0.25	0.30
2.55	2.65	2.75
2.55	2.65	2.75
0.35	0.40	0.45
FUSE LEAD		

Notes

1. Pin 1 identifier can be a combination of a dot and/or chamfer.
2. Dimensions are in millimeters.

LEAD FINISH

The package leads are Nickel Palladium Gold (NiPdAu). The configuration being manufactured and delivered today is lead-free RoHS compliant. Compliant packages have half-etch leadframes and have date codes of 0300 or greater.

LEAD FREE QFN SURFACE MOUNT APPLICATION

Please see Application Note AN310 for assembly process recommendations. Application Notes can be found at our website: www.honeywell.com/microwave

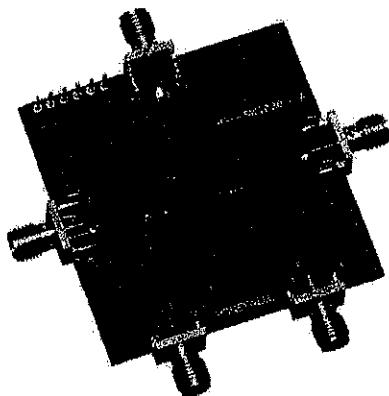
CIRCUIT APPLICATION INFORMATION

These attenuators require a DC reference to ground. They may not operate properly when AC coupled on both the RF input and output without a DC ground reference provided as part of the circuit. See Application Note AN311.

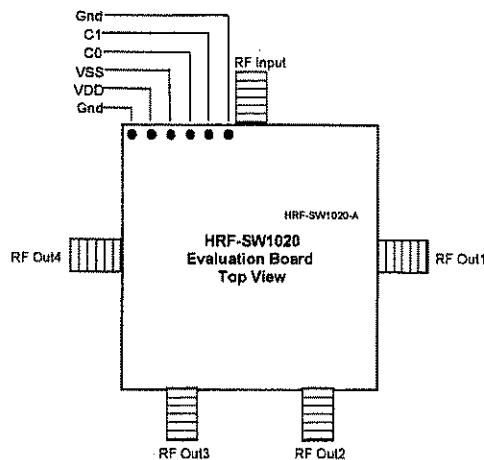
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EVALUATION CIRCUIT BOARD

Honeywell's evaluation board provides an easy to use method of evaluating the RF performance of our switch. Simply connect power, DC and RF signals to be measuring switch performance in less than 10 minutes.



HRF-SW1020 Evaluation Board



EVALUATION CIRCUIT BOARD LAYOUT DESIGN DETAILS

Item	Description
PCB	Impedance Matched Multi-Layer FR4
Switch	HRF-SW1020 RF Switch
Chip Capacitor	Panasonic Model ECU-E1C103KBQ Capacitor, .01uf 0402 10% 16V
RF Connector	Johnson Connectors Model 142-0701-801 SMA RF Coaxial Connector
DC Pin	Mil-Max Model 800-10-064-10-001 Header Pins

ORDERING INFORMATION

Ordering Number	Delivery Method	Units Per Shipment
HRF-SW1020-AU-TR	Tape & Reel	2500 Units per Reel
HRF-SW1020-AU-T	Tape	< 2500
HRF-SW1020- E	Evaluation Board	One Board Per Box

FIND OUT MORE

For more information on Honeywell's Microwave Products visit us online at www.honeywell.com/microwave or contact us at 800-323-8295 (763-954-2474 internationally).

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